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CLAIMS

1. A laminated holographic medium comprising:

one or more first core layers;

one or more diffraction grating layers for recording data provided upon, under or in the first core layers, formed by converting a form or a refractive index distribution and from which a reproduction beam goes out; and

one or more recording layers provided adjacent to the first core layer or the diffraction grating layer for recording data or provided binding a gap layer between the recording layer and the core layer or the diffraction grating layer for recording data, and on which information data is recorded in a form of a recording mark transmittance or non-transmittance of light indicating the information data in accordance with a presence of a hole or a degree of transmittance of the light.

2. The laminated holographic medium according to claim 1, wherein

the diffraction grating layer for recording data is formed in order to indicate the presence and a position of the recording mark by a presence of brightness/darkness and a position of light when the reproduction beam is transmitted through the recording layer.

3. The laminated holographic medium according to claim 1, wherein

the diffraction grating layers for recording data comprise a function of a hologram.

4. The laminated holographic medium according to claim 1, further comprising:

a reflection layer provided at an opposite side of the recording layer

with respect to the first core layers and the diffraction grating layer for recording data and which reflects the light transmitted through the recording layer.

5. A laminated holographic medium comprising:

one or more first core layers; and

one or more diffraction grating layers for recording data provided upon, under or in the first core layers, formed by converting a form or a refractive index distribution and from which a reproduction beam goes out, wherein

in the diffraction grating layers for recording data, the information data is recorded in a form of a recording mark indicating information by a presence of the outgoing reproduction beam caused by a shape, changes of a refractive index or a removal of the diffraction grating layers.

6. The laminated holographic medium according to claim 1, further comprising:

one or more second core layers provided on or under the first core layers;

a cladding layer provided between the first core layers and the second core layers; and

a diffraction grating layer provided on, under or in the second core layers on which the information data is recorded by applying a shape or changes of a refractive index distribution.

7. A laminated holographic medium, comprising:

one or more recording layers on which information data is recorded as a recording mark having transmittance or non-transmittance of light indicating information by using a presence of a hole or a degree of

transmittance of the light.

8. The laminated holographic medium according to claim 7, further comprising:

a diffraction grating layer for recording data formed by converting a form or a refractive index distribution and which receives the light transmitted via the recording layer and forms an image at a predetermined position.

9. The laminated holographic medium according to claim 7, further comprising:

one or more second core layers provided adjacent to the recording layers or next to the recording layers with a gap layer in between; and  
one or more diffraction grating layers for recording data provided upon, under or in the second core layers, and to which the information data is recorded by converting a form or a refractive index distribution.

10. A reproduction apparatus reproduces information data recorded on a laminated holographic medium according to claim 1, comprising:

an optical head radiates an incident light into the first core layer;  
and  
a photodetector detects light transmitted through the recording layer.

11. The reproduction apparatus according to claim 10, further comprising:

a reflection portion that reflects the light transmitted via the recording layer, wherein  
the photodetector detects the light transmitted from the recording layer via the reflection layer.

12. A reproduction apparatus that reproduces information data recorded on a laminated holographic medium according to claim 5, further comprising:  
     an optical head that radiates incident light onto the first core layers;  
 and  
     a photodetector that detects light transmitted through the recording layer.
13. A reproduction apparatus reproduces information data recorded on a laminated holographic medium according to claim 7, comprising:  
     a light source radiates light on the recording layer; and  
     a photodetector detects light transmitted through the recording layer.
14. A reproduction apparatus reproduces information data recorded on a laminated holographic medium according to claim 7, further comprising:  
     a light source that radiates light on the recording layer;  
     an image formation optical system that reflects the light reflected by the recording layer and forms an image from the light; and  
     a photodetector that detects the light formed by the image formation optical system.
15. A reproduction method that reproduces information data recorded on the laminated holographic medium according to claim 1, comprising the steps of:  
     radiating incident light onto the first core layers;  
     detecting the reproduction beam coming out from the diffraction grating layer for recording data via the recording layer; and  
     reproducing the information data recorded on the recording layer in

accordance with a brightness/darkness pattern corresponding to the presence of the recording mark on the recording layer.

16. A reproduction method that reproduces information data recorded on the laminated holographic medium according to claim 5, comprising the steps of:

- radiating the incident light onto the first core layers;
- detecting the reproduction beam coming out from the diffraction grating layer for recording data; and
- reproducing the information data recorded on the diffraction grating layer for recording data in accordance with a brightness/darkness pattern corresponding to the presence of the recording mark on the recording layer.

17. A reproduction method that reproduces information data recorded on the laminated holographic medium according to claim 7, comprising the steps of:

- radiating light onto the recording layer;
- detecting light through the recording layer; and
- reproducing the information data recorded on the recording layer in accordance with a brightness/darkness pattern corresponding to the presence of the recording mark on the recording layer.

18. A reproduction method that reproduces information data recorded on the laminated holographic medium according to claim 7, comprising the steps of:

- radiating light onto the recording layer;
- detecting the light reflected by the recording layer; and
- reproducing the information data recorded on the recording layer in accordance with a brightness/darkness pattern corresponding to the presence

of the recording mark in the recording layer.

19. A recording apparatus that records information data onto the laminated holographic medium according to claim 1, comprising:

a beam radiation system that radiates a beam onto the recording layer and draws or projects the information data as a whole, or

an electron beam radiation system that radiates an electron beam onto the recording layer and draws or projects the information data as a whole.

20. A recording method that records information data onto the laminated holographic medium according to claim 1, comprising the steps of:

recording the information data in a form of the recording mark having transmittance or non-transmittance of light onto the recording layer by drawing or projecting the information data as a whole using a beam or an electron beam.

21. A production method of the laminated holographic medium according to claim 1, comprising the steps of:

exposing the recording layer;

recording the information data on the recording layer; and

forming and adhering other layer independently produced.

22. A reproduction apparatus that reproduces information data recorded on a laminated holographic medium including one or more first core layers provided at predetermined positions; one or more diffraction grating layers for recording data provided upon, under or in the first core layers, formed by converting a form or a refractive index distribution and from which a reproduction beam goes out; and one or more recording layers provided

adjacent to the first core layers or the diffraction grating layers for recording data or provided next to the core layer or the diffraction grating layer for recording data with a gap layer in between, and to which information data is recorded as a recording mark having transmittance or non-transmittance of light indicating the information data in accordance with a presence of a hole or a degree of transmittance of light, comprising:

a position detection unit detecting the predetermined position of the first core layers;

an optical head that radiates incident light onto the first core layers;

a shifting unit that shifts the optical head to the predetermined position upon detecting attachment of the laminated holographic medium or turning on; and

a photodetector that detects light transmitted through the recording layer.

23. A reproduction method that reproduces information data recorded on a laminated holographic medium including one or more first core layers provided at predetermined positions; one or more diffraction grating layers for recording data provided upon, under or in the first core layers, formed by converting a form or a refractive index distribution and from which a reproduction beam goes out; and one or more recording layers provided adjacent to the first core layer or the diffraction grating layer for recording data or provided next to the core layer or the diffraction grating layer for recording data with a gap layer in between, and to which information data is recorded as a recording mark having transmittance or non-transmittance of light indicating the information data in accordance with a presence of a hole or a degree of transmittance of the light, comprising steps of:

detecting the predetermined position of the first core layer;

radiating incident light onto the first core layer upon detecting

attachment of the laminated holographic medium or turning on; and

reproducing the information data recorded on the recording layer in accordance with a brightness/darkness pattern corresponding to the presence of the recording mark on the recording layer.

24. A laminated holographic medium of a laminated holographic memory system, wherein

the laminated holographic memory system includes

the laminated holographic medium that comprises: a core layer into which incident light comes; and a diffraction grating layer formed by converting a form or a refractive index distribution and from which a reproduction beam goes out; and

a reproduction apparatus that comprises an aperture mask separating and reproducing recorded information, that is multiplexed, by shading a portion of the reproduction beam, wherein the reproduction apparatus radiates the incident light and detects the reproduction beam, and

the laminated holographic medium that comprises:

a recording layer comprising a recording mark provided at a position where an aperture gap of the aperture mask does not overlap, which indicates information by a presence of a hole in order to transmit or shade light or by a degree of transmittance of the reproduction beam; and

a diffraction grating layer for recording data that is formed in order to indicate the presence and a position of the recording mark on a recording layer by a presence of brightness/darkness and a position of light upon reproducing with the reproduction apparatus.

25. A laminated holographic medium of a laminated holographic memory system, wherein

the laminated holographic memory system includes:



the laminated holographic medium that comprises: a core layer into which incident light comes; and a diffraction grating layer formed by converting a form or a refractive index distribution and from which a reproduction beam goes out; and comprises:

a reproduction apparatus radiating the incident light and detecting the reproduction beam, and

the laminated holographic medium comprises:

a recording layer comprising:

a shading portion that is partly made from a colored material and shades the reproduction beam; and

a recording mark that expresses information by a presence of a hole that transmits or shades the reproduction beam except for position of the shading portion, or by a degree of transmissivity of the reproduction beam; and

a diffraction grating layer for recording data that is formed to express the presence and a position of the recording mark on the recording layer by a presence of brightness/darkness and a position of light upon reproducing with the reproduction apparatus.

26. A laminated holographic medium of a laminated holographic memory system, wherein

the laminated holographic memory system includes:

the laminated holographic medium comprising;

a core layer to which an incident light comes in;

and

a diffraction grating layer that is formed by converting a form or a refractive index distribution and from which a reproduction beam goes out; and comprises

a reproduction apparatus that radiates the incident light

and detects the reproduction beam, and

a recording layer that comprises a recording mark that is provided at a position that is transformed in accordance with a predetermined regulation and based on a presence of brightness/darkness and a position of the reproduction beam radiated on the reproduction apparatus determined beforehand, and that expresses information by a presence of a hole that transmits or shades light or by a degree of transmittance of the reproduction beam; and

a diffraction grating layer for recording data that is formed to reproduce the presence and a position of the recording mark on a recording layer corresponding to the presence of brightness/darkness and the position of the reproduction beam determined beforehand by reproducing with the reproduction apparatus.

27. The laminated holographic medium according to claim 26, wherein the predetermined regulation is a regulation of reversing the brightness/darkness from the reproduction beam, reversing a position upside-down, or right and left, reversing presence, or shifting the recording mark for a predetermined distance up, down, left or right.

28. The laminated holographic medium according to claim 26, wherein the predetermined regulation is a regulation of arranging the presence and the position of the recording mark on the recording layer to have a relationship with a brightness/darkness and a position of the reproduction beam to be one-to-many, many-to-many, or many-to-one.

29. A design method of producing a laminated holographic medium of a laminated holographic memory system, wherein the laminated holographic memory system includes:

the laminated holographic medium that comprises:

a core layer into which incident light comes; and

a diffraction grating layer that is formed by converting a form or a refractive index distribution and from which a reproduction beam goes out; and

a recording layer comprising a recording mark that expresses information by a presence of a hole that transmits or shades light or by a degree of transmittance of the reproduction beam; and comprises:

a reproduction apparatus comprising an aperture mask that separates and reproduces multiplexed recorded information by shading a portion of the reproduction beam, wherein the reproduction apparatus radiates the incident light and detects the reproduction beam, and

the design method of producing the laminated holographic medium of the laminated holographic memory system comprising the steps of:

providing the recording mark at a position that does not overlap an aperture gap of the aperture mask;

forming a diffraction grating layer for recording data in order to express the presence and a position of the recording mark on a recording layer by a presence of brightness/darkness and a position of construction beam upon reproducing with the reproduction apparatus.

30. A design method of producing a laminated holographic medium of a laminated holographic memory system, wherein

the laminated holographic memory system includes:

the laminated holographic medium comprising:

a core layer into which incident light comes;

a diffraction grating layer that is formed by converting a form or a refractive index distribution and from which a reproduction beam goes out; and

a recording layer that comprises:

a shading portion that is partly made from a colored material and that shades the reproduction beam; and

a recording mark that expresses information by a presence of a hole that transmits or shades the reproduction beam except for a position of the shading portion, or by a degree of transmissivity of the reproduction beam, and

a reproduction apparatus that radiates the incident light and detects the reproduction beam, and

the design method of producing the laminated holographic medium of the laminated holographic memory system comprising the steps of:

providing the recording mark at a position that does not overlap the shading portion; and

forming a diffraction grating layer for recording data in order to express the presence and a position of the recording mark on a recording layer by a presence of brightness/darkness and a position of light upon reproducing with the reproduction apparatus.

31. A design method of producing a laminated holographic medium of a laminated holographic memory system, wherein

the laminated holographic memory system includes

the laminated holographic medium comprising:

a core layer into which incident light comes;

a diffraction grating layer that is formed by converting a form or a refractive index distribution and from which a reproduction beam goes out; and

a recording layer that comprises a recording mark that expresses information by a presence of a hole that transmits or shades light or by a degree of transmittance of the reproduction beam, and comprises

a reproduction apparatus that radiates the incident light and detects the reproduction beam, and

the design method of producing the laminated holographic medium of the laminated holographic memory system comprising the steps of:

providing the recording mark at a position transformed in accordance with a predetermined regulation and based on a presence of brightness/darkness and a position of the reproduction beam on the reproduction apparatus determined beforehand,

forming a diffraction grating layer for recording data in order to express the presence and a position of the recording mark on a recording layer by the presence of brightness/darkness and the position determined beforehand of the reproduction beam upon reproducing with the reproduction apparatus.

32. An authentication sheet comprising:

one or more first core layers;

one or more diffraction grating layers for recording data provided upon, under or in the first core layer, formed by converting a form or a refractive index distribution and from which a reproduction beam goes out; and

one or more recording layers provided adjacent to the first core layers or the diffraction grating layers for recording data or provided next to the core layers or the diffraction grating layers for recording data with a gap layer in between, and to which information data is recorded as a recording mark having transmittance or non-transmittance of light indicating the information data by a presence of a hole or a degree of transmittance of the light.

33. The authentication sheet according to claim 32, wherein

the diffraction grating layer for recording data is formed in order to indicate the presence and a position of the recording mark by a presence of brightness/darkness and a position of light when the reproduction beam is transmitted through the recording layer.

34. A reproduction apparatus that reproduces information data recorded on the authentication sheet according to claim 32, comprising:

an optical head radiates incident light onto the first core layer; and  
a photodetector detects light transmitted through the recording layer.

35. A reproduction method for reproducing information data recorded on the authentication sheet according to claim 32, comprising steps of:

radiating the incident light into the first core layer;  
detecting the reproduction beam outgoing from the diffraction grating layer for recording data through the recording layer; and  
reproducing the information data recorded on the recording layer in accordance with a brightness/darkness pattern corresponding to the presence of the recording mark on the recording layer.

36. A recording apparatus for recording information data on the authentication sheet according to claim 32, comprising:

a beam radiation system that radiates a beam onto the recording layer and drawing or projecting the information data as a whole, or  
an electron beam radiation system that radiates an electron beam onto the recording layer and drawing or projecting the information data as a whole.

37. A recording method for recording information data on the

authentication sheet according to claim 32, comprising steps of:

recording the information data as the recording mark having transmittance or non-transmittance of the light on the recording layer by drawing or projecting the information data as a whole by using a beam or an electron beam.

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